Measurement of Continuous-Energy Neutron-Incident Neutron-Production Cross Section

Nobuhiro Shigyo[1], Satoshi Kunieda[1], Takehito Watanabe[1], Shusaku Noda[1], Kenji Ishibashi[1], Yosuke Iwamoto[2], Daiki Satoh[2], Takashi Nakamura[3], Robert C. Haight[4]

[1] *Department of Applied Quantum Physics and Nuclear Engineering, Kyushu University*
[2] *Japan Atomic Energy Research Institute*
[3] *Department of Quantum Science and Energy Engineering, Tohoku University*
[4] *Los Alamos National Laboratory*

Intermediate-energy proton accelerators are applicable to facilities such as accelerator-driven subcritical systems, which have aroused a great deal of interest in cross sections in this intermediate-energy region. For design of facilities, proton-incident double-differential cross sections (DDX) have been measured. These data contributed to improvement of calculation codes. Proton-incident data, however, give limited information on the reaction. At the intermediate energies, protons induce the cascade reaction dominantly starting from the initial p-n collision for heavy neutron-rich targets. Neutron-incident DDX data will play an important role in quantitatively understanding the whole cascade process. Neutron-incident data, however, have not been obtained above 100 MeV at all.

It is well known that the optical potential changes significantly around 100 MeV. Proton-incident data cover this region to some extent. It is necessary for the neutron-incident DDX data also to cover the nuclear-potential changing region. Neutron-incident data will give information complementary to proton-incident data with regard to intra-nuclear cascade codes and the optical potential.

The experiment was performed at the Weapons Neutron Research (WNR) facility of Los Alamos Neutron Science Center. The flight time of the emitted neutron was not obtained directly. To avoid this difficulty, the energy of emitted neutron was obtained by the energy deposition in a detector. The incident neutron energy was gotten by the time-of-flight method between the accelerator and the emitted neutron detector. Two types of detectors were adopted to measure a wide energy range of neutrons. Liquid organic scintillators covered emitted neutron energies up to 100 MeV. Recoil proton detectors, which consist of recoil proton radiators and phoswich-type NaI(Tl) scintillators, were used for neutrons above several tens MeV into the several hundred MeV range. Iron and lead were used as sample materials. The experimental data were compared with the evaluated nuclear data and with the results of GNASH and PHITS codes. The details of experiment will be presented at the poster session.

Email: shigyo@kune2a.nucl.kyushu-u.ac.jp